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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MISCHA MAGENS, PIERRE WILTZIUS,
and SHU YANG

Appeal 2008-3269
Application 10/040,017
Technology Center 1700

Decided:[1] May 7, 2009

Before BRADLEY R. GARRIS, CATHERINE Q. TIMM, and
LINDA M. GAUDETTE, *Administrative Patent Judges.*

GAUDETTE, *Administrative Patent Judge.*

DECISION ON APPEAL

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[1] The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, begins to run from the Decided Date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision finally rejecting claims 1-10, 14-20, 22, 23, and 26-29 (Final Office Action, mailed Oct. 20, 2006), the only claims pending in the application. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

STATEMENT OF THE CASE

The "invention relates to artificially constructing crystalline structures." (Spec. 1:4.) Claims 1 and 14 are illustrative of the subject matter on appeal, and are reproduced from the Claims Appendix to the Appeal Brief ("App. Br."), filed Dec. 4, 2006:

1. A method, comprising:

exposing a photo-sensitive medium to an optical intensity pattern under conditions that inhibit or prevent the optical intensity pattern from producing refractive index changes in the medium; and

then, heating the exposed medium to stimulate a pattern of refractive index changes that is responsive to the optical intensity pattern during the exposing,

wherein the medium comprises acid neutralizer molecules and a material capable of undergoing a refractive index changing chemical reaction.

14. A method for making crystalline structures and devices, comprising:

providing a medium comprising acid neutralizer molecules, a material capable of undergoing a refractive index changing chemical reaction and photo-sensitizer molecules dispersed therein, the photo-sensitizer molecules to catalyze photo-chemical reactions in response to being activated by light of a wavelength, products of the photo-chemical reactions being able to

stimulate the refractive index changes in the medium; and

exposing the medium to an optical interference pattern that is produced by combining a plurality of mutually coherent beams of light of the wavelength, the exposing being done under conditions that inhibits or prevents the products of the photo-chemical reactions from causing the refractive index changes.

The Examiner relies on the following evidence to establish unpatentability (Supplemental Examiner's Answer ("Ans."), mailed Aug. 15, 2007, 3):

Cowan	4,402,571	Sep. 6, 1983
Neckers	5,639,802	Jun. 17, 1997
Oxman	WO 99/62460	Dec. 9, 1999
Popovich	6,115,152	Sep. 5, 2000

M. Campbell et al., "Fabrication of Photonic crystals for the visible spectrum by holographic lithography", Nature vol. 404, pp. 63-56 (March 2, 2000).

A. J. Tuberfield et al., "Photonic Crystals made by Holographic lithography", MRS Bull., pp. 632-636 (August 2001).

Appellants request review of the following grounds of rejection (App. Br. 5-6):

1. claims 1-10, 14-20, 22, 23, and 26-29 under 35 U.S.C. § 103(a) as unpatentable over either Campbell or Turberfield in view of Popovich, Neckers, and Oxman; and

2. claims 1-10, 14-20, 22, 23, and 26-29 under 35 U.S.C. § 103(a) as unpatentable over either Campbell or Turberfield in view of Popovich, Neckers, and Oxman, further in view of Cowan.

The Argument section of the Appeal Brief (pp. 6-21) includes two separate headings, one relating to claims 1-10, 19, 22, 23, 28, and 29 (section VII. C.) and one relating to claims 14-18, 20, and 26-27 (section VII. D). However, Appellants present identical arguments in each of these sections. (*Compare* App. Br. 9-14 *with* App. Br. 15-21; *see generally*, Rep. Br. (absence of arguments directed to any specific claim).) Accordingly, we confine our discussion of the issue raised in this Appeal to independent claim 14.[2, 3] We also confine our discussion of the primary references to Campbell. (*See*, *infra*, FF 5 (citing App. Br. 6).)

ISSUE

Have Appellants shown reversible error in the Examiner's determination that it would have been obvious to have modified Campbell's method to achieve Appellants' claimed method by including Popovich's photoinitiator dye and amine coinitiator in Campbell's photoresist?

We answer this question in the negative.

FINDINGS OF FACT ("FF")

1. Appellants' claimed method requires "a medium comprising acid neutralizer molecules, a material capable of undergoing a refractive index changing chemical reaction and photo-sensitizer molecules dispersed therein." (Claim 14.)

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[2]Appellants' remarks with respect to independent claim 1 (App. Br. 10) are not considered an argument for separate patentability. *See* 37 C.F.R. § 41.37(c)(1)(vii) ("A statement which merely points out what a claim recites will not be considered an argument for separate patentability of the claim.").

[3] All the argued claim limitations appear in both independent claims 1 and 14. Therefore, the issue is the same for both independent claims and our discussion with respect to one claim is equally applicable to the other.

2. According to the Specification, exemplary photosensitive starting media are photoresists. (Spec. 7:6-7.) Materials capable of undergoing a refractive index changing chemical reaction include resins of epoxide oligomers, such as EPON SU-8. (Spec. 7:10-13.) Exemplary photo-sensitizer molecules are dyes that are activated by visible light (Spec. 7:14-16), such as Rose Bengal (Spec. 7:21). "[A]n appropriate [acid] neutralizer is a base such as triethyl amine or N,N,2,4,6-pentamethylaniline." (Spec. 11:16-19.)

3. Appellants claimed method further requires that "the photo-sensitizer molecules" are capable of "catalyz[ing] photo-chemical reactions in response to being activated by light of a wavelength, products of the photo-chemical reactions being able to stimulate the refractive index changes in the medium." (Claim 14.)

4. The Specification describes the reaction mechanism which occurs during the inventive method as follows:

A molecule of dye is activated by absorption of a photon. (Spec. 8:3-4.) The activated dye molecule transfers energy to an ionic initiator complex (Spec. 8:5), i.e., a photoacid generator (PAG) such as "OPPI" (Spec. 7:24-29). The resultant activated ionic initiator then decays to produce a pair of free radicals, one of which reacts with a hydrogen atom of a solvent molecule (Spec. 8:6-9), e.g., "a non-nucleophilic solvent" (Spec. 7:7). The complex formed is unstable and decays to produce a free hydrogen cation, H^+ (Spec. 8:10-11). When the temperature is increased, a sequence of polymerization reactions begin when an H^+ ion attacks the epoxide ring of the oligomer. (Spec. 8:24-27.)

5. Campbell discloses a three-dimensional holographic lithography technique (p. 53, col. 1) which utilizes a photoresist containing "Epon-SU8 dissolved in γ-butyrolactone . . . with a triaryl suphonium salt . . . acting as a photoacid generator" (p. 54, col. 1 (citation omitted)). In Campbell's method, the photoresist is exposed to UV radiation for a duration of 6 ns. (p. 54, col. 1). Campell discloses that "[a]bsorption of an ultraviolet photon by a molecule of photoacid generator liberates a hydrogen ion" (p. 54, col. 1). Campbell states that "acid-catalysed polymerization does not occur until the film is heated in a post-exposure bake" (p. 54, col. 1 (citation omitted); *see also*, Oxman (11:5-8), discussed, *infra*, FF 11 (identifying reaction temperature as a variable in polymerization and noting that "some compositions which do not successfully polymerize . . . at one reaction temperature may successfully polymerize at a higher temperature")). (*See* App. Br. 6 (acknowledging the foregoing disclosure in Campbell and conceding that Turberfield is a review article describing Campbell's disclosure).)

6. The Examiner concedes that Campbell does not disclose Appellants' claimed "neutralizer molecules (amines) or the use of spectral sensitizers." (Ans. 8.) However, the Examiner maintains that it would have been obvious to modify the method of Campbell to include these features, thereby achieving the claimed invention. (Ans. 8.) As motivation for the proposed modification, the Examiner specifically relies on "[t]he benefit of spectral sensitization in general [] articulated in the holographic arts by Popovich." (Ans. 11-12; *see also*, Ans. 8.) The Examiner also relies on Popovich's disclosure of the desirability of using an amine coinitiator in the formulation of the hologram to "control[] the rate of curing in the free

radical polymerization reaction of the prepolymer material" (col. 8, ll. 57-59). (Ans. 8; *see also*, Ans. 12 ("The benefit is the spectral sensitization and the effect of the amine as a co-initiator.").) Popovich discloses that triethyl amine (col. 8, ll. 63-64; *see also*, col. 9, ll. 1-6) and Rose Bengal ester (col. 8, ll. 46-47) are a suitable coinitiator and photoinitiator dye, respectively, for use in producing holographic optical elements for visible light (col. 8, ll. 50-52). (*See* Ans. 4-5, 8.)

7. The Examiner relies on Neckers to establish that one of ordinary skill in the art would have had a reasonable expectation of success in using dyes and amine co-initiators such as those taught by Popovich in Campbell's method for the purpose of sensitizing the onium salts and facilitating cationic polymerization of the oligomer. (Ans. 9.)

8. Neckers discloses a photohardenable composition that is said to be useful in photosensitive materials including photoresists. (Col. 5, ll. 27-38.) Neckers' composition comprises "[a] cationically polymerizable compound" which "may be an epoxy compound" (col. 5, ll. 16-18) such as a Novolak resin (col. 22, l. 63), and "an onium salt capable of initiating cationic polymerization of [the] polymerizable compound upon exposure to actinic radiation." (Col. 5, ll. 8-13.) Epon SU-8, the oligomer used in the present invention and in Campbell (*see*, *supra*, FF 5), is a polymeric solid epoxy novolac resin. Hexion Technical Data Sheet, EPON Resin SU-8 (Re-issued September 2001), available at http://www.hexion.com/Products/TechnicalDataSheet.aspx?id=3603 (accessed Apr. 29, 2009).

9. Neckers' composition further comprises a xanthene or fluorone dye, and a hydrogen donor. Neckers discloses a wide range of dyes for use

as the photoinitator, including Rose Bengal (col. 5, ll. 43-46). Neckers also discloses the use of N,N,2,4,6-pentamethylaniline (col. 11, ll. 6-7) as a hydrogen donor, coinitiator (col. 10, ll. 47-49). Neckers acknowledges the known use of triarylsulfonium salts as cationic photoinitiators in UV curing based on the cationic polymerization of epoxy resins. (*See*, *infra*, FF 13.) In Neckers Example 4, control samples, i.e., without dye, were prepared with OPPI and with triaryl sulfonium, the photoacid generator used in Campbell (*see*, *supra*, FF 5). Neckers states that "OPPI" is a "[p]articularly preferred iodonium salt[]" for use in the disclosed composition. (Col. 10, ll. 42-46.)

10. The Examiner also cites Oxman for a disclosure of the effects of adding an amine to a cationically curable composition, and describes the reference as going "beyond the reasonable expectation of success." (Ans. 9.)

11. Oxman relates to photopolymerizable compositions which include epoxy resins (3:7-8), onium salts, in particular "iodonium salts (e.g., aryl iodonium salts)" for "initiating both free radical and cationic polymerization" (7:18-24), a visible light sensitizer (11:26-27), such as a xanthene dye (12:2), and a cationic polymerization modifier, such as triethyl amine (11:22-24). According to Oxman, "[t]he inventors have discovered that . . . these modifiers not only delay the onset of cationic polymerization, but, upon initiation, increase the rate of polymerization relative to the rate of polymerization in the absence of the cationic polymerization modifier conducted under the same irradiation conditions." (11:15-19.)

12. Appellants argue that the Examiner's proposed motivation for modifying Campbell is based on improper hindsight reasoning. (*See generally*, App. Br. 11-13, 17-20.) According to Appellants, Campbell's

method requires a short duration of UV radiation exposure to achieve the desired results. Appellants argue that "Popovich and Necker's use of much higher doses or durations of visible light exposure . . . would have deterred one of ordinary skill in the art from modifying Campbell . . . to include Popovich's photoinitiator dye." (Reply Brief ("Rep. Br."), filed May 18, 2007, 2.) In particular, Appellants contend that the ordinary artisan would have expected the increased doses or durations of visible light exposure to create "photo-induced changes in refractive index and/or mechanical vibrations of optical components" which Campbell seeks to avoid through the use of a short UV exposure time. (Rep. Br. 3-4.)

13. According to Neckers, at the time of their invention, "[s]ignificant advances in UV curing based on the cationic polymerization of epoxy resins and in photoimaging technology based on photochemically induced acidolysis [had] been made following the discovery of thermally stable and highly efficient cationic photoinitators such as . . . triarylsulfonium . . . salts." (Col. 1, ll. 26-32.) Neckers further explains that "although many efforts [had] been made to develop a visible light cationic initiating system, no satisfactory system [had] been found." (Col. 2, ll. 63-5.) Neckers' invention is thus directed to a composition that "can be polymerized by cationic initiation upon exposure to radiation . . . extending into the visible spectrum." (Col. 4, ll. 19-22.)

14. Cowan was relied on by the Examiner in the second ground of rejection to further support the Examiner's determination that it would have been obvious to have used a visible laser in place of Campbell's UV laser. (Ans. 7.) Appellants do not present separate arguments with respect to Cowan, and do not refute the Examiner's finding that the use of a visible

lasers was well known in the holographic arts (*id*). (*See generally*, App. Br. 9-21; Rep. Br.)

PRINCIPLES OF LAW

In considering the question of the obviousness of a claimed invention in view of the prior art relied upon, we are guided by the basic principle that the question under 35 U.S.C. § 103 is not merely what the references expressly teach, but what they would have suggested to one of ordinary skill in the art at the time of the invention. *See Merck & Co., Inc. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807-08 (Fed. Cir. 1989); *In re Keller,* 642 F.2d 413, 425 (CCPA 1981) ("The test for obviousness is not . . . that the claimed invention must be expressly suggested in any one or all of the references.").

In an obviousness analysis, it is appropriate to consider:

> interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed.

KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 418 (2007).

"For obviousness under § 103, all that is required is a reasonable expectation of success." *In re O'Farrell*, 853 F.2d 894, 903-04 (Fed. Cir. 1988) (citations omitted).

"A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994).

ANALYSIS

Appellants essentially argue that the Examiner's proposed motivation for combining the references is not supported by the evidence of record: "the Examiner has ignored the benefits of the short exposure time with ultraviolet light, as taught by Campbell or Turberfield, in favor of the Examiner's own speculative advantages." (Rep. Br. 3.) Contrary to Appellants' contention, we find that the evidence of record supports the Examiner's finding that "the practical difference in exposure times [would not] offset the benefit of spectral sensitivity" (Ans. 13). In particular, we note that Neckers explicitly discusses prior efforts to develop a visible light cationic initiating system based on known methods of using UV light in cationic polymerization of epoxy resins (*see* FF 13). (*See also*, FF 6, 11 (Popovich and Oxman disclosures describing the benefits of the photoinitiator dye ("photo-sensitizer molecules") and amine ("acid neutralizer molecules")).)

"[W]here the prior art gives reason or motivation to make the claimed [invention] . . . the burden (and opportunity) then falls on an applicant to rebut that *prima facie* case." *In re Dillon*, 919 F.2d 688, 692-93 (Fed. Cir. 1990) (*en banc*). For the reasons explained by the Examiner in the Answer (*see generally*, Ans. 10-14), Appellants' arguments do not establish that the reference teachings would have discouraged the ordinary artisan from modifying Campbell's method in the manner proposed by the Examiner to achieve Appellants' claimed method. Appellants have not provided any other evidence in support of nonobviousness.

Accordingly, we find that a preponderance of the evidence favors the Examiner's conclusion that claims 1-10, 14-20, 22, 23, and 26-29 are obvious over Campbell or Turberfield in view of Popovich, Neckers, and Oxman, with or without Cowan. We sustain both grounds of rejection.

CONCLUSION

Appellants have not identified reversible error in the Examiner's determination that it would have been obvious to have modified the method of Campbell to achieve Appellants' claimed method by including Popovich's photoinitiator dye and amine coinitiator in the Campbell photoresist. The decision of the Examiner rejecting claims 1-10, 14-20, 22, 23, and 26-29 is affirmed.

No time period for taking any subsequent action in connection with this appeal maybe extended under 37 C.F.R. § 1.136(a)(1)(v).

AFFIRMED

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